Study on the Acceptability of Travel Reservation Considering the Socio-Demographic Characteristics of Travelers

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Abstract: In order to mitigate traffic congestion and protect the environment, this paper proposes a traffic management policy called travel reservation policy. The successful implementation of policies depends on the study of the acceptability of policies. Therefore, to accomplish the analysis of acceptability, questionnaire surveys were carried out with travelers who live in Suzhou, Jiangsu Province. The collected data were processed and analyzed in Statistical Product Service Solutions (SPSS) using the Mann–Whitney U test. As a result, more than half of travelers were willing to accept policies regarding travel reservation. Acceptability was found to be higher with increase in age and decrease in the number of private cars during the survey. The results can be informative and practically used for developing travel reservation policies.

Keywords: Reservation, acceptability, hypothesis testing, questionnaire, socio-demographic characteristics

1. INTRODUCTION

Traffic congestion and the resultant accidents, pollution and energy have become the key challenge to social and economic development, especially against the increasingly limited road resources and steadily increasing travel demand. Although the refined measurements and implementations of traffic management and control have alleviated the conflicts between traffic supply and demand to some extent, cities are still faced with serious traffic jam, for example, on the critical links that connect the major trip destinations and no ideal alternative is available. In this case, reservation can be an effective solution to assign the limited service capacity of the key links and to avoid serious traffic congestion.

Reservation, defined as the procedure for the public to get permission and secure their right for use of road resources by reserving it in advance[1], has seen wide application to transportation areas such as airways[2-3], sea cargo[4], railways[5], and parking[6] in addition to other fields such as hotel[7] and hospital[8]. By reserving the service, the travelers are guaranteed of the rights to use the service or facility that has limited capacity. Chen et al. discussed smartphone-based parking reservation systems and applied the Vickrey-Clark-Groves mechanism to determine parking fees, taking into account the cruising and walking times of parking, which was proved to reduce social parking cost by up to 38%[9]. Kaspi et al. improved the performance of one-

way vehicle sharing systems by incorporating parking reservation policies[10]. Using a Markovian model, they took into account the total trip delay in the system, i.e. the difference between the actual travel time and the shortest possible travel time from the desired starting point to the desired destination. The findings of this paper suggested that the incorporation of parking reservation policies in vehicle sharing systems was capable of improving the level of service quality.

Roadway reservation concept has also been widely explored and improved by transportation engineers. Su et al. proposed a roadway reservation system concept and tested its feasibility through simulations using a VISSIM microscopic traffic simulator[11]. The results showed that as traffic demand increased, the reservation scenario outperformed the baseline in terms of Vehicles-Hours-Traveled (VHT) and CO2 emissions. When the travel demand on freeway was 30% higher than the capacity, the total VHT was reduced by 24.6% from the baseline, and the CO2 emissions were reduced by 18.3%. Menelaou et al. proposed two possible reservation strategies, a) vehicles could wait at intermediate road junctions, or b) vehicles could wait only at the origin (delayed departure)[12]. Using time expanded shortest path algorithm, they proved that predetermined routes can greatly improve road utilization.

In the field of Intelligent Transport Systems (ITS), Nielsen[13] described acceptability as related to the question of whether the system is good enough to satisfy all the needs and requirements of the users and other potential stakeholders. Schade and Schlag[14] described acceptability as the prospective judgement before such future introduction. In this paper, the respondents will not have experienced any of the measures or devices in practice, which makes acceptability a construction of attitude. Public acceptability has been researched as a critical issue in the transportation field, specifically for new congestion relief tools and new technology initiatives such as ITS. Chung et al. proposed a new strategy to mitigate freeway traffic congestion and to analyze public discourse and acceptability for the new traffic control policy[1]. They obtained data through questionnaires modeled using structural equations and came to a conclusion: 66% of respondents agreed with the proposed policy; 24% of them disagreed and the remaining gave the no-comment response. Additionally, the married and female respondents tended to show higher acceptability. Schlag and Schade proposed a series of traffic management measures for traffic problems such as traffic congestion and air pollution of motor vehicles, such as improving public transport and access restrictions. According to the data, people's acceptance of the former management measures was about 94%, while the acceptance of the latter access restrictions was only 68%[15].

As previously stated, the discussions on travel reservations have been mainly concentrated on theoretical and technical components without detailed analyze the impact of socio-demographic characteristics on acceptability. Therefore, this paper will analyze this content. This paper defines reservation acceptability as the attitude toward procedure for the public to get permission and secure their right for use of road resources by reserving it in advance before travel. In order to explore the reservation acceptability of potential travelers, it is necessary to analyze the influencing factors of the socio-demographic characteristics and take some targeted measures to improve the acceptability of reservation.

Gender, age, income, number of family members and private cars are considered to influence how people think about reservation acceptability and therefore on the implementation of the reservation policy. In previous research, there were no consistent results concerning

whether/how gender affects the likelihood of travel planning and booking, such as Mobility-as-a-service (MaaS). Ho et al. found that gender had no significant effect on the choice of a MaaS plan[16], but Chung et al. found that female respondents tended to have higher acceptability of a travel reservation strategy[17]. In terms of age, younger people such as category 18–25 and 25–35 years old were more positively inclined to MaaS subscription than the other age categories. In contrast, people aged older than 51 were less likely to subscribe to MaaS[18]. In terms of monthly income, Kim et al. reported that those in the highest income brackets were more likely to choose MaaS plans[19]. In terms of number of family members, Chung et al. observed that public acceptability of freeway booking policy was found to be higher among respondents with the larger number of family members[17]. In terms of private cars, Ho et al. noted that users who didn't use cars very often (1 or 2 days per week) are most likely to choose MaaS products, and those who didn't use cars are the least[16].

In summary, the mainly influencing factors of socio-demographic characteristics of travelers included gender, age, monthly income and number of family members and private cars. The remainder of the paper is organized as follows: Section 2 presents the basic overview and statistical data of the questionnaire; Section 3 describes the test methods and results and Section 4 provides the final conclusions and proposes future lines of research.

2. SURVEY AND DATA

In order to clearly understand the travelers' acceptability of travel reservation, this paper conducts a questionnaire of travel reservation in Gusu District, Xiangcheng District, Industrial Park District, Wuzhong District, Wujiang District and Huqiu District around the ancient city area of Suzhou City (Figure 1) with limited road resources and increasingly serious congestion problems. First of all, the basic overview of the questionnaire survey is elaborated, and then the major statistics are introduced.
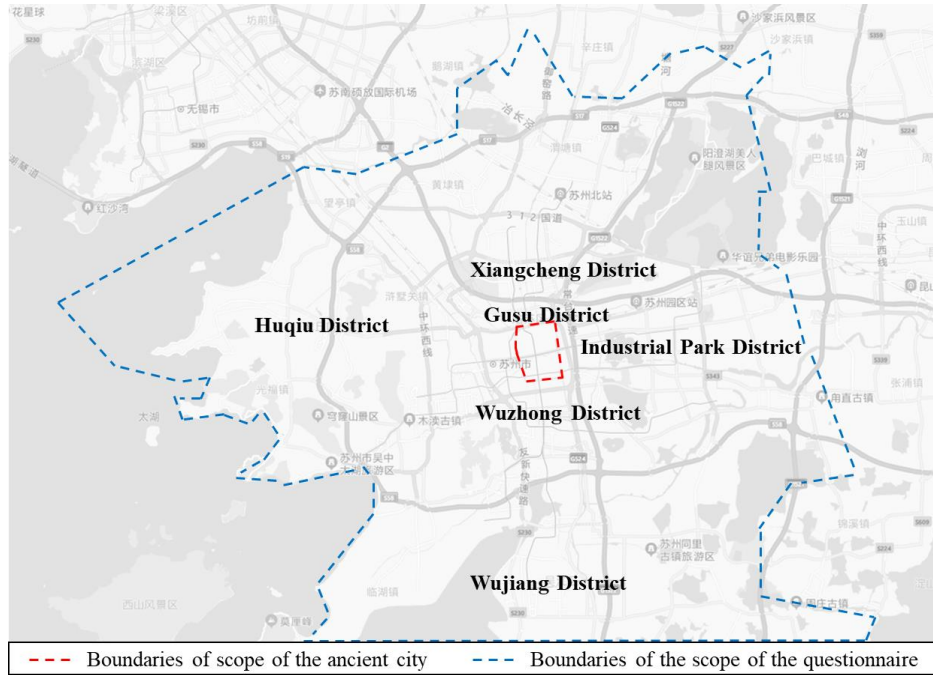
Figure 1. Boundaries of scope of the ancient city and the questionnaire.

2.1 Basic overview of the questionnaire survey

Surveys were carried out during weekdays and weekends (January 9, 12 and 15, 2022) in shopping malls, parks of the ancient city area, Olympic sports center and other areas with large flow of people of different types in Suzhou, so as to obtain more comprehensive samples. Each interview lasted an average of 8 min. Respondents were asked to complete the survey only once. A total of 1054 effective samples were collected in this survey.

The questionnaire was composed of two sequential parts: (1) the first part was about the socio-demographic characteristics of the respondents, including gender, age, monthly income, number of family members in Suzhou, number of private cars, (2) the second part was the respondents' acceptability of travel reservation policy, including degree of acceptability to reduce travel by private car and to increase the use of bus or rail under the policy of requiring private cars to make a reservation in advance in order to protect the environment and control congestion in the ancient city.

2.2 Major statistics and presentations

For the statistical analysis, the questionnaire was grouped into the above two aspects that influence the acceptability of reservation policy, and the descriptive statistics of the survey results are summarized in Table 1.

Table 1. Descriptive statistics of the survey results.

Variables	Number	Percentage	Variables	Number	Percentage
Socio-demographic characteristics					
Gender			¥3,000-¥5,000	172	16.32%
Male	471	44.69%	¥5,000-¥10,000	360	34.16%
Female	583	55.31%	¥10,000-¥30,000	196	18.60%
Age			>¥30,000	32	3.04%
<18 years old	49	4.65%	**Number of family members in Suzhou**		
18-25 years old	416	39.47%	1 person	224	21.25%
26-35 years old	348	33.02%	2 persons	100	9.49%
36-45 years old	137	13.00%	3 persons	339	32.16%
46-55 years old	72	6.83%	≥4 persons	391	37.10%
56-65 years old	22	2.09%	**Number of private cars**		
>65 years old	10	0.95%	0 car	295	27.99%
Monthly income			1 car	538	51.04%
<¥3,000	294	27.89%	≥2 cars	221	20.97%
Acceptability					
Reduce travel by private car			**Increase the use of bus or rail**		
Very reluctant	44	4.18%	Very reluctant	26	2.47%
Reluctant	76	7.21%	Reluctant	35	3.32%
Just OK	230	21.82%	Just OK	178	16.89%
Willing	333	31.59%	Willing	381	36.15%
Very willing	371	35.20%	Very willing	434	41.18%

As shown in the table, female was the major class at 55.31%. Most of the people surveyed were in two age groups: 18–25 and 26–35. In terms of monthly income, 5,000-10,000 yuan and less than 3,000 yuan were relatively high, accounting for 34.16% and 27.89%. Additionally, in terms of the number of family members in Suzhou, the number of 3 persons and more than 4 persons was relatively high, accounting for 69.26%, so it is more likely to travel collectively, and the probability of using individual transportation is higher; the number of people who own private cars accounted for 72.01%, so the respondents with private cars are more likely to use private cars, which reflects the respondents' strong dependence on individual transportation modes.

Finally, two questions about the acceptability of the trip reservation policy were asked in terms of five levels from very reluctant to very willing, i.e. (1) whether travelers are willing to reduce travel by private car under the policy that private cars must be reserved in advance before they travel, and (2) whether travelers are willing to increase the number of bus or rail usage under the policy that private cars must be reserved in advance before they travel. In the first question, the positive responses including 'willing' and 'very willing' were about two-thirds (66.79%); the negative respondents were only 11.39%, and the remaining had no comment about the policy. Considering the no comment responses, it can be concluded that respondents' acceptability of this question is about 88.61%. In the second question, the positive responses including 'willing' and 'very willing' were about 77.33%; the negative

respondents were only 5.79%, and the remaining had no comment about the policy. Considering the no comment responses, it can be concluded that respondents' acceptability of this question is about 94.22%. Combining the two questions, almost all (98%) of the respondents who were willing to reduce travel by private car were also willing to increase the use of bus or rail, and 28% of the respondents who were reluctant to reduce travel by private car were also reluctant to increase the use of bus and rail, which reflects the fixity of the travel mode.

3. METHOD AND RESULT

3.1 Analytical method

In order to understand the differences of the respondents with different socio-demographic characteristics in their acceptability of changing the use of private transport and public transport under the travel reservation policy, the collected data were analyzed using IBM SPSS Statistics 26. Statistical techniques such as hypotheses test were used to achieve the objectives of this study. The following hypotheses (Table 2 and Table 3) have been developed to test differences in the acceptability of respondents with different characteristics in terms of changing the use of private and public transport under travel reservation policies.

Table 2. Hypotheses in terms of changing the use of private transport under travel reservation policies.

Hypothesis	Description
H1a	Female are more willing to reduce the use of private cars than male under the travel reservation policy
H2a	People aged > 35 are more willing to reduce the use of private cars than those aged $\leqslant$ 35 under the travel reservation policy
H3a	People with medium and high income ($\geqslant$ 5,000 yuan) are more willing to reduce the use of private cars than people with low income (< 5,000 yuan) under the travel reservation policy
H4a	People with complex families ($\geqslant$ 3 persons) are more willing to reduce the use of private cars than single / childless people (< 3 persons) under the travel reservation policy
H5a	People without private cars (0 car) are more willing to reduce the use of private cars than those with private cars ($\geqslant$ 1 car) under the travel reservation policy

Table 3. Hypotheses in terms of changing the use of public transport under travel reservation policies.

Hypothesis	Description
H1b	Female are more willing to increase the use of buses or tracks than male under the travel reservation policy
H2b	People aged > 35 are more willing to increase the use of buses or tracks than those aged $\leqslant$ 35 under the travel reservation policy
H3b	People with medium and high income ($\geqslant$ 5,000 yuan) are more willing to increase

the use of buses or tracks than people with low income (< 5,000 yuan) under the travel reservation policy

| | H4b | People with complex families (≥ 3 persons) are more willing to increase the use of buses or tracks than single / childless people (< 3 persons) under the travel reservation policy |
| | H5b | People without private cars (0 car) are more willing to increase the use of buses or tracks than those with private cars (≥ 1 car) under the travel reservation policy |

(1) Kolmogorov-Smirnov test

Before hypotheses testing, we use Kolmogorov-Smirnov test (K-S test), which is applicable to 75 or larger sample sizes[20], to test whether the data obey normal distribution. We process variables as shown in Table 4 below.

Table 4. The variable being processed.

Variables	Type	Value
Socio-demographic characteristics		**(Divided into group 1 and group 2)**
Gender	Nominal	0 (male), and 1(female)
Age	Ordinal	0 (aged <18, 18-25, and 25-35), and 1 (aged 36-45, 46-55, 56-65, and >65)
Monthly income	Ordinal	3,000 (<¥3,000, and ¥3,000-¥5,000), 10,000 (¥5,000-¥10,000, ¥10,000-¥30,000, and > ¥30,000)
Number of family members in Suzhou	Ordinal	0 (1 person, and 2 persons), 1 (3 persons, and ≥4 persons)
Number of private cars	Ordinal	0 (0 car), 1 (1 car, and ≥2 car)
Acceptability		
Reduce travel by private car	Ordinal	0 (very reluctant), 1 (reluctant), 2 (just OK), 3 (willing), and 4 (very willing)
Increase the use of bus or rail	Ordinal	0 (very reluctant), 1 (reluctant), 2 (just OK), 3 (willing), and 4 (very willing)

The initial examination and testing of the data (Table 5) showed that the p-value of the K-S test of each hypothesis was less than 0.05, and the data do not meet the requirements of an approximately normal distribution, which are necessary to apply parametric tests. Therefore, a non-parametric statistical testing approach was used to analyze the collected data[21]. According to the recommendations of Rivera et al.[22] and Song and Wang (2009)[23], the Mann-Whitney U test, which was able to assess whether the central tendencies of two independent samples are different, was used to calculate the results of the survey. The Mann–Whitney U test has great significance when the data are not normally distributed.

Table 5. Initial examination and testing of the data.

Hypothesis	Variables	K-S test (p-value)	Method
H1a/H1b	Gender	0.00	
H2a/H2b	Age	0.00	
H3a/H3b	Monthly income	0.00	Mann–Whitney U Test
H4a/H4b	Number of family members in Suzhou	0.00	
H5a/H5b	Number of private cars	0.00	

(2) Mann–Whitney U test

The hypothesis mentioned was checked by using the Mann–Whitney U test: as shown in Table 6 and Table7, the test results are the p-values of the hypothesis H2a, H5a, and H5b to be 0.021, 0.028, and 0.011, respectively. Therefore, the above p-value is less than 5%. The p-value of the remaining hypothesis is greater than 5%.

Table 6. Hypotheses result in terms of changing the use of private transport under travel reservation policies.

Hypothesis	Variables	Mean		Mann–Whitney U Test			
		Group 1	Group 2	Mann–Whitney U	Wilcoxon W	Z	p-value
H1a	Gender	2.80	2.92	131493.500	242649.500	-1.235	0.217
H2a	Age	2.82	3.00	88777.500	419668.500	-2.316	0.021*
H3a	Monthly income	2.86	2.87	91615.000	116815.000	-0.348	0.728
H4a	Number of family members in Suzhou	2.87	2.86	136355.500	245166.500	-0.138	0.890
H5a	Number of private cars	2.99	2.81	102634.000	391054.000	-2.197	0.028*

* means p<0.05

Table 7. Hypotheses result in terms of changing the use of public transport under travel reservation policies.

Hypothesis	Variables	Mean		Mann–Whitney U Test			
		Group 1	Group 2	Mann–Whitney U	Wilcoxon W	Z	p-value
H1b	Gender	3.06	3.14	132006.500	243162.500	-1.149	0.251
H2b	Age	3.07	3.20	90384.500	421275.500	-1.950	0.051
H3b	Monthly income	3.09	3.11	91468.000	116668.000	-0.394	0.694
H4b	Number of family members in Suzhou	3.14	3.07	132577.500	305743.500	-0.962	0.336
H5b	Number of private cars	3.23	3.05	101433.000	389853.000	-2.530	0.011*

* means p<0.05

3.2 Result and discussion

As shown in Table 8, this section summarizes the results of all the hypotheses in Table 6 and Table 7. Hypotheses where the p-value is less than 5% are statistically significant (Accepted), and test values where the p-value is more than 5% are considered statistically insignificant (Rejected).

Table 8. Results of all the hypotheses.

Hypothesis	Status	Hypothesis	Status
H1a	Rejected	H1b	Rejected
H2a	Accepted	H2b	Rejected
H3a	Rejected	H3b	Rejected
H4a	Rejected	H4b	Rejected
H5a	Accepted	H5b	Accepted

In hypothesis H2a, respondents aged >35 had an average of 3.00 of their acceptability for reducing travel by private car, while respondents aged less than or equal to 35 had an average of 2.8. As a result, respondents older than 35 are more willing to accept reducing travel by private cars. Similarly, it can be concluded that respondents who do not have private cars are more willing to reduce travel by private cars and increase the number of buses or rails used.

The reasons for this may be due to: (1) Respondents over the age of 35 do not make reservations because they have been travelling with their private cars for many years, thus they doesn't want to change their habits, or they are not particularly keen to use smartphones, or they think reservation through a smartphone can be tedious; (2) Respondents don't make reservations because they don't have private cars, so they are more acceptability in reducing travel by private cars and increasing the number of buses or rails used. In conclusion, consideration could be given to improving the acceptability of travel reservations by simplifying the travel reservation process. Additionally, it is also important and necessary to take some measures to publicize the policy in the form of the Internet or the media, which can help the public understand the social benefits of the travel reservation policy, such as reducing traffic congestion and reducing environmental pollution. These measures will contribute to the successful implementation of the travel reservation policy.

4. CONCLUSION

In this paper, we collected data on the acceptability of travel reservation in the form of questionnaires, and conducted statistical analysis of the survey data, which accumulated experience for the practice of travel reservation policies. In the future, we can further explore the research and practice of reservation in different scenarios, carry out travel reservation services in multiple scenarios, continuously improve the acceptability of travel reservations, and promote the orderly transformation of the future transportation system.

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